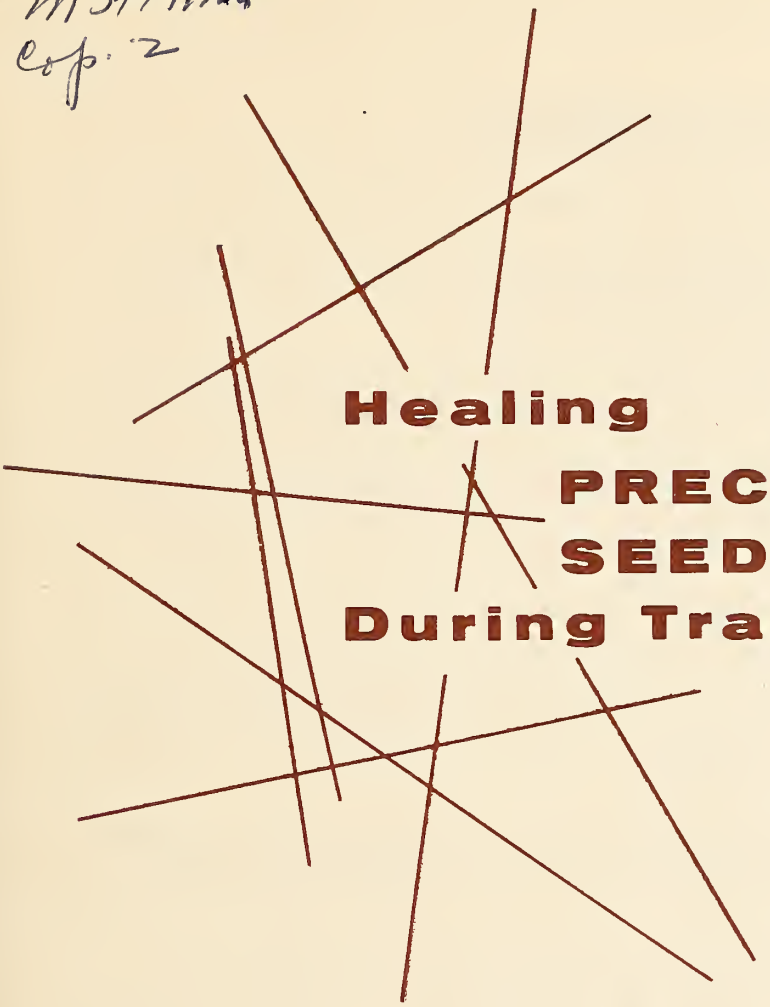
AMS-334



Healing PRECUT POTATO SEED PIECES During Transit

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Marketing Research Division
Agricultural Research Service
Crops Research Division

ACKNOWLEDGMENTS

The authors appreciate the assistance of the following cooperators:

Reiner Bonde, Don Merriam, and Charles Cunningham of the University of Maine for assistance in making arrangements with shippers during the preliminary tests in 1957.

Paul Eastman of the Maine State Division of Plant Industry for certification of the test loads under a special test regulation.

Frank D. O'Brien, Charles Hickson, Richard Sprague, Armand Duplisse, Fred Lunt, and Arthur Bowen of the Bangor and Aroostook Railroad for selecting and scheduling cars.

Stanley P. Greaves and Jim Day of the Maine Potato Shippers Heater Service for supplying and servicing alcohol heaters.

George Barnes, Robert A. Mullaney, and Hugh McWilliams of the Eastern States Farmers Exchange for supplying the seed potatoes and collecting data on arrival conditions.

Willfred Guerette and George Bishop, Aroostook County, Maine, for cutting the seed and loading the cars at their respective potato houses.

Robert B. Myers, Fred Irwin, Allen Greiss, Charles Dutton, Robert Dostal, Morgan Price, W. John Blatt, John L. Epler, Harvey R. Gamble, Harold Mengel, and Philip L. Downie for scheduling and unloading the cars at the destination.

CONTENTS

SUMMARY

Five 50,000-pound test carloads of certified Katahdin seed potatoes were machine precut in Maine during March and April 1958, immediately placed into 100-pound burlap bags, and loaded (500 bags per car) into preheated, insulated, fan-equipped refrigerator railroad cars. Each bunker contained one 13,000-B.t.u. per hour alcohol heater with thermostat set at 60° F. for operation during preheating, loading, and transit. Relative humidity in the car atmosphere was generally 90 percent or higher. Temperatures of potatoes in storage prior to loading averaged 42°, 46°, 43°, 47° and 48° respectively for the five tests. All potato temperatures were at least 50° within 1 day, 55° within 2 days, and 60° within 3 days following cutting and loading. Temperatures of potato seed pieces rose steadily during transit and ranged from 61° to 83° F. at time of unloading. Potatoes were above 60° F. for 2-1/2 to 5 days in the various carloads. The precut seed pieces arrived in excellent healed-over condition ready to store or plant. Weight loss during transit was low. The test potatoes were distributed to about 125 growers in Connecticut, Massachusetts, Pennsylvania, and Rhode Island.

HEALING PRECUT POTATO SEED PIECES DURING TRANSIT

H. W. Hruschka, W. L. Smith, Jr., and H. V. Toko
Biological Sciences Branch, Agricultural Marketing Service
and
R. V. Akeley
Vegetable and Ornamentals Research Branch, Agricultural Research Service

BACKGROUND

The ability of the potato to recover from wounds and to form a protective skin covering on cut surfaces has been known for a long time (3, 5).[1] Optimum conditions needed for wound healing which involves suberization and wound periderm formation are generally considered to include fairly high temperature and humidity (about 60° F. or slightly higher and 85 to 95 percent relative humidity) and a good air supply circulated freely around the exposed cut surfaces (2, 6). Many tests comparing freshly cut seed potatoes with whole seed and with seed cut and then stored for various lengths of time have been conducted (1, 4, 7, 8, 9). These tests have shown that precutting far ahead of planting time usually did not affect the stand and yield of potatoes provided the seed pieces were held under conditions favorable for healing of the cut surfaces.

Potato growers, however, prefer small whole seed potatoes, even at a premium price, rather than large ones, largely because of the expense of cutting the larger potatoes and the lack of facilities on most farms for healing seed pieces that have been cut ahead of planting. Consequently, the larger seed potatoes are sold on the table-stock market. Seed growers are therefore obliged to expand their expensive certified seed program which otherwise could be reduced if all the large-sized tubers were utilized for seed.

A workable system for cutting and healing potato seed pieces before planting could provide benefits in several ways. The reduced acreage needed could be more carefully tended to produce better quality seed. Properly healed cut seed would be less subject to rot either in storage or after planting than freshly cut seed. More efficient use of cutting machines in the seed-producing areas and reduced need for expensive labor for hand cutting in the seed-using areas could bring savings to both groups.

This study was undertaken to determine the practicability of precutting seed potatoes in commercial seed-producing areas and providing favorable conditions for healing the cut surfaces during transit to the seed-using areas.

MATERIALS AND PROCEDURE

A preliminary test load of potatoes, consisting of 200 bags of precut seed, was shipped to Pennsylvania in 1957 and was well-received by farmer cooperators. Five carloads, each containing 500 100-pound bags of precut potato seed pieces cut in Aroostook County, Maine, were shipped to Connecticut, Massachusetts, Pennsylvania, and Rhode Island during the 1958 season.

Cars and Heaters

Modern, well built end-bunker refrigerator fan cars were used in these tests. The cars were well insulated so that heat loss could be held to a minimum. The wall flues, which provide added insulation, were sealed off at the top in these tests with a 6-inch strip of paper (fig. 1) to prevent air from bypassing the load and to force as much air as possible through the load. The floor racks were left uncovered (except for a small space

[1] Underscored figures in parentheses refer to Literature Cited, page 24.

BN-8665-x

Figure 1.--Applying paper over top of wall flues to prevent air from bypassing load.

BN-8670-x

Figure 2.--Alcohol heaters with 13,000 BTU/hour full burner capacity used to supply heat for suberization.

at the doorway in tests 1 and 2) to permit the warm air to pass through the load and thus warm the seed pieces.

Each of the two end bunkers was equipped with a modern alcohol heater (fig. 2). The heaters were rated at approximately 13,000 B.t.u. per hour full burning capacity and 750 B.t.u. per hour capacity "on pilot." They were fueled with a mixture of 2/3 methyl alcohol and 1/3 isopropyl alcohol with a rated output of 11,186 B.t.u. per pound.

The cars and heaters were selected and inspected at Northern Maine Junction, Bangor, Maine, the day before loading. The electric fans were set in the "on" or operating position and thus functioned whenever the car was in motion. The heater thermostats were set at 60° F. and the burners lit. Thereafter, the heaters were burning until the end of each test.

Following servicing, each car was moved approximately 180 miles to the potato storage siding in time for the start of loading early the next day. Thus, each car had ample time for preheating prior to loading.

Potatoes and Seed Cutting Machines

Katahdin variety certified seed potatoes 2" to 3-1/8" in size, grown and stored in Maine, were used in all tests. At time of removal from the storage bins some sprouting had occurred. Sprouted potatoes were desprouted by normal handling in the sizing and grading operation before they were cut.

Both semi-automatic machines (fig. 3) cutting blocky seed pieces and automatic machines (fig. 4) which cut the potatoes into long seed pieces were used.

The seed potatoes were moved by conveyor from the storage bins to the sorting table and thence to the seed-cutting machine. Depending on the machine used, the potatoes were placed on the machine either automatically or by hand. The cut seed was bagged (into one-hundred-pound-capacity burlap bags measuring 14" by 11" by 33" when full) immediately following cutting, and the filled bags were loaded directly into the preheated car.

Loads and Loading

Car loading started between 7 and 8 a.m. A canvas wind-proof tunnel (fig. 5) was installed between the car and potato house. One end of the car was completely loaded before the end of the first work day. The loading of the remainder of the car was completed by the end of the next work day.

Each carload consisted of 500 bags. Five tiers of 45 bags each were placed into each end of the car. The individual bags within each tier were placed lengthwise of the car in seven layers of 6, 7, 6, 7, 6, 7, 6 bags in the respective layers (fig. 6). The remaining 50 bags were placed crosswise in the doorway area in two rows. In tests 1 and 2 the 33" by 60" floor space remaining (enough for 25 additional bags) was covered with a strip of car liner paper to block off air flow. In tests 3, 4, and 5 this space was filled with bags taken from the top layer of the load. The load height ranged from 62 to 65 inches above the floor racks with 27 to 24 inches of air space remaining above the load. The fan openings were clear, thus allowing free air flow.

Use of Hold Motor

After loading the first end of each car, a canvas tarpaulin was secured to the walls, ceiling, and floor of the car, completely confining the air circulation system in that end of the car. This canvas was removed just before loading was completed, and the car doors were closed.

BN-8668-x

Figure 3. --Semi-automatic potato seed cutter used for precutting seed at shipping point.

BN-8666-x

Figure 4. -- Automatic potato seed cutter used for sizing and precutting seed at shipping point

Figure 5.--Canvas loading tunnel installed between the potato house and insulated car to prevent heat loss during loading.

BN-8669-x

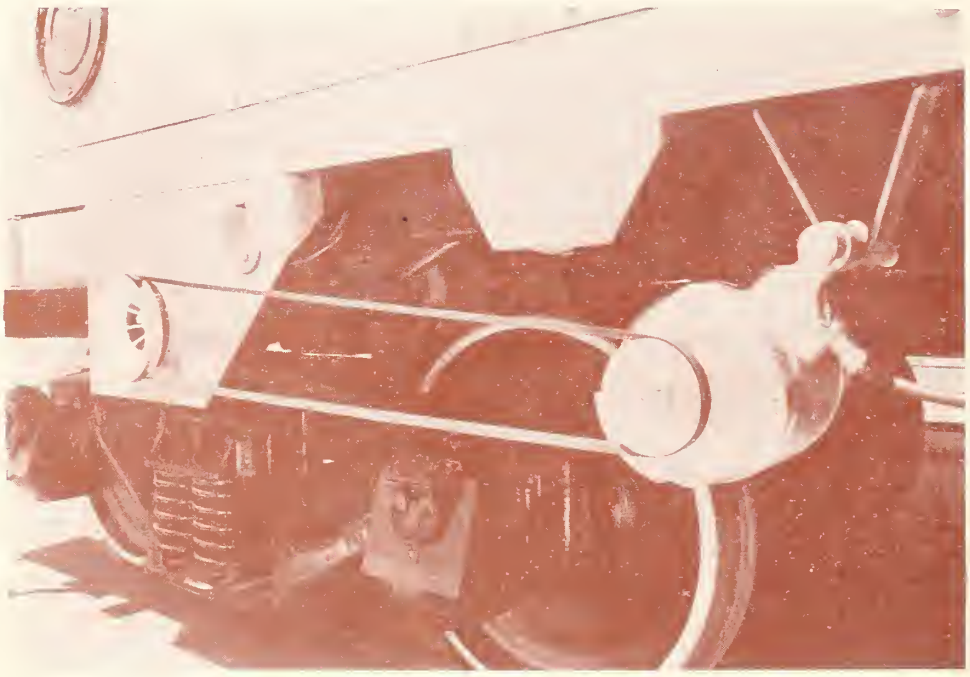
A hold motor, improvised by using an electric motor of 3/4 hp. and 1,750 r.p.m. capacity, was then installed outside the car to operate the car fan pulley and drive the electric car fans (fig. 7). Air was thus circulated within the canvas-isolated end of the car at about 12 c.f.m. per 100-pound bag. The motor was operated until the car left the loading siding. This was done to simulate commercial conditions for loads completed in one day and immediately started moving to market. When the car is moving the overhead electric fans are operated by means of a generator powered from the car wheel rotation. Floor fans are operated directly by the car wheels with a pulley drive.

Recording Temperatures

Temperature records of the precut potato seed pieces during transit were obtained with small recording thermometers (fig. 8) placed in bags in the quarter-length position (midway between the doorway and bunker) of each end of the car in the bottom, middle, and top layer positions. Air temperatures were recorded at the ceiling at one quarter-length position and underneath the floor rack at the doorway. Outside air temperatures were recorded with a thermometer fastened underneath the car.

BN-8663-x

Figure 6.--The load pattern of seven layers with 6, 7, 6, 7, 6, 7, 6 bags allowed ample head room for air flow from the fans.



BN-8667-x

Figure 7.--A type of electric hold motor which may be used to operate fans while cars are on siding prior to transit.

RESULTS

Temperatures

Temperatures recorded are given in tables 1-5 and figures 9-11.

Outside air temperatures were mild during March and April 1958 in the areas traversed by the five test cars. These temperatures, with normal variation, averaged about 40° F. for each of the first two tests, about 45° for the third and fourth tests, and 55° for the fifth test. Apparently the outside temperatures had little influence on temperatures in the cars during these tests. This was probably due to the mildness of the air temperatures, the relatively small spread between outside and inside temperatures, and the good insulation and general condition of the cars.

Inside air temperatures, as would be expected, were higher at the ceiling than at the floor position. Daily averages ranged from 58° to 78° F. at the ceiling position and 45° to 69° at the floor position. Maximum temperature spread in fan cars was, due to air stratification which occurred when the cars were not moving and the fans stopped. Fan action reduces this spread by circulating heated air from the bunkers out over and down through the load and back under the floor racks to the bunker.

The temperature of the potatoes, which in storage averaged 42°, 46°, 43°, 47° and 48° F. in tests 1 to 5, respectively, rose a few degrees during cutting, bagging, and loading. Depending somewhat on potato temperatures during loading, temperatures of cut seed potatoes reached 50° within about 1 day following loading, 55° within 2 days, and 60° within 3 days. Warmer (51°) potatoes reached these temperatures one day sooner than cool (44°-46°) potatoes and thus the cut surfaces had one day longer to heal at the more favorable temperatures (fig. 9). Seed pieces loaded on the first day also reached these temperatures about 1 day sooner than those loaded on the second day in the same car (fig. 10).

Top-layer seed warmed fastest, mid-layer seed next, and bottom-layer seed warmed slowest (fig. 11 and table 6). These differences were caused by direction of the air flow from the fans and by temperature stratification of the air within the car, which occurs when the cars are standing.

In general, temperatures of the seed pieces rose about 7° per day until 60° F. (heater thermostat setting) was reached and thereafter rose 1-1/2° to 3° per day. Temperatures at unloading ranged from 61° in test 1 to 85° in test 5. Heat of respiration supplemented by heat from the heater pilots and heat generated by fan action accounts for most of the rise.

Relative Humidity

Humidity in the car atmosphere was spot checked before departure from Maine and after arrival at the growing areas by means of a battery-driven psychrometer. At both origin and destination relative humidity was high, with readings approximately 90 percent or higher in the car atmosphere. The relative humidity within the bags, near the seed piece surfaces, must have been somewhat higher. Moisture produced by seed piece respiration and alcohol combustion provided excellent humidity conditions for wound healing during the entire transit period.

Condition of Load

The loads traveled well en route from Maine to destination with little shifting or settling in transit. No mechanical damage to seed pieces or bags was found. A few bags toppled into an open space in the load at one side of the doorway. This trouble was avoided in the last 3 tests by rearranging the load to fill this gap with some of the top-layer bags.

BN-8664-x

Figure 8. --Recording thermometers, placed in car body or in potato bags, were calibrated and marked before enclosing in metal cover.

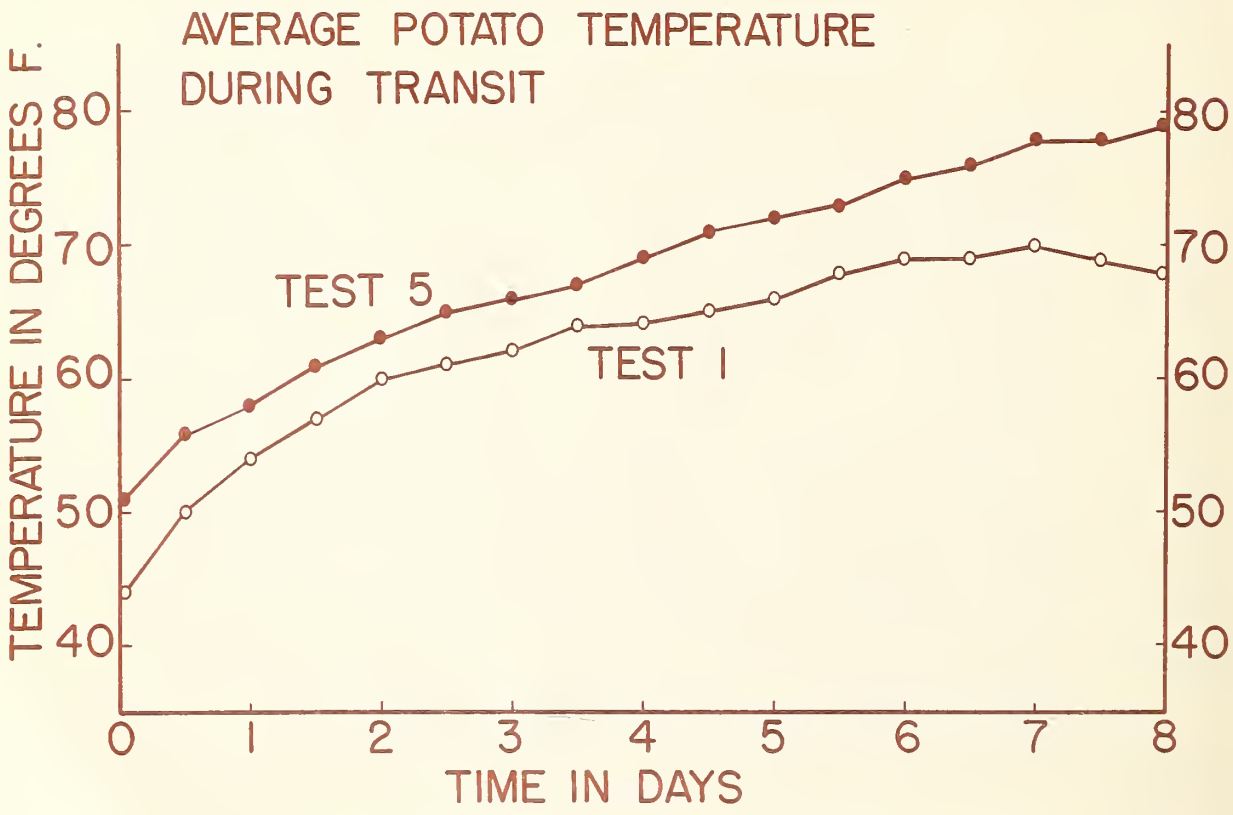


Figure 9. --Transit temperatures of potatoes in two carloads with different starting temperatures.

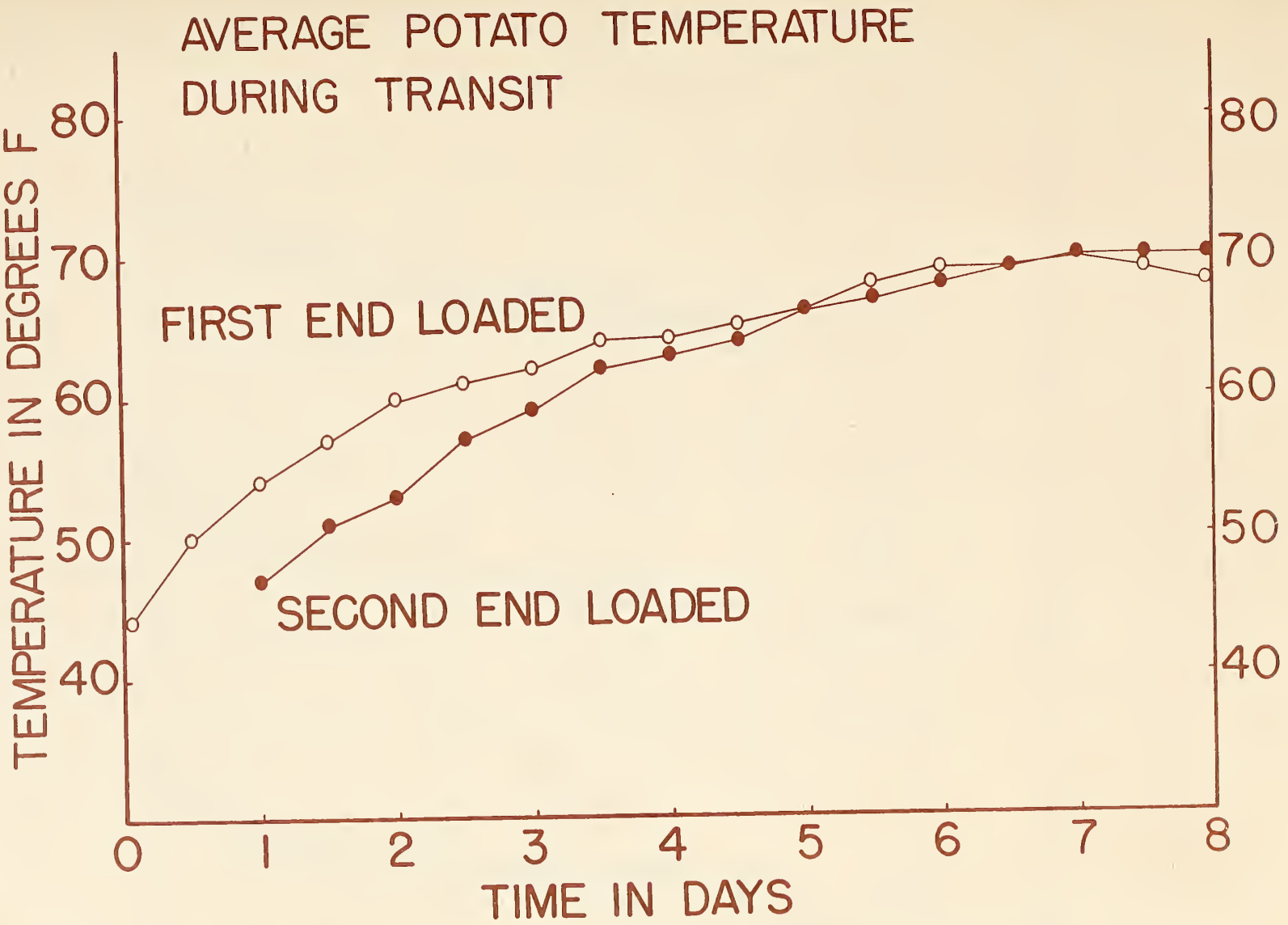


Figure 10. --Transit temperatures of potatoes in two ends of a car loaded in consecutive days, test 1.

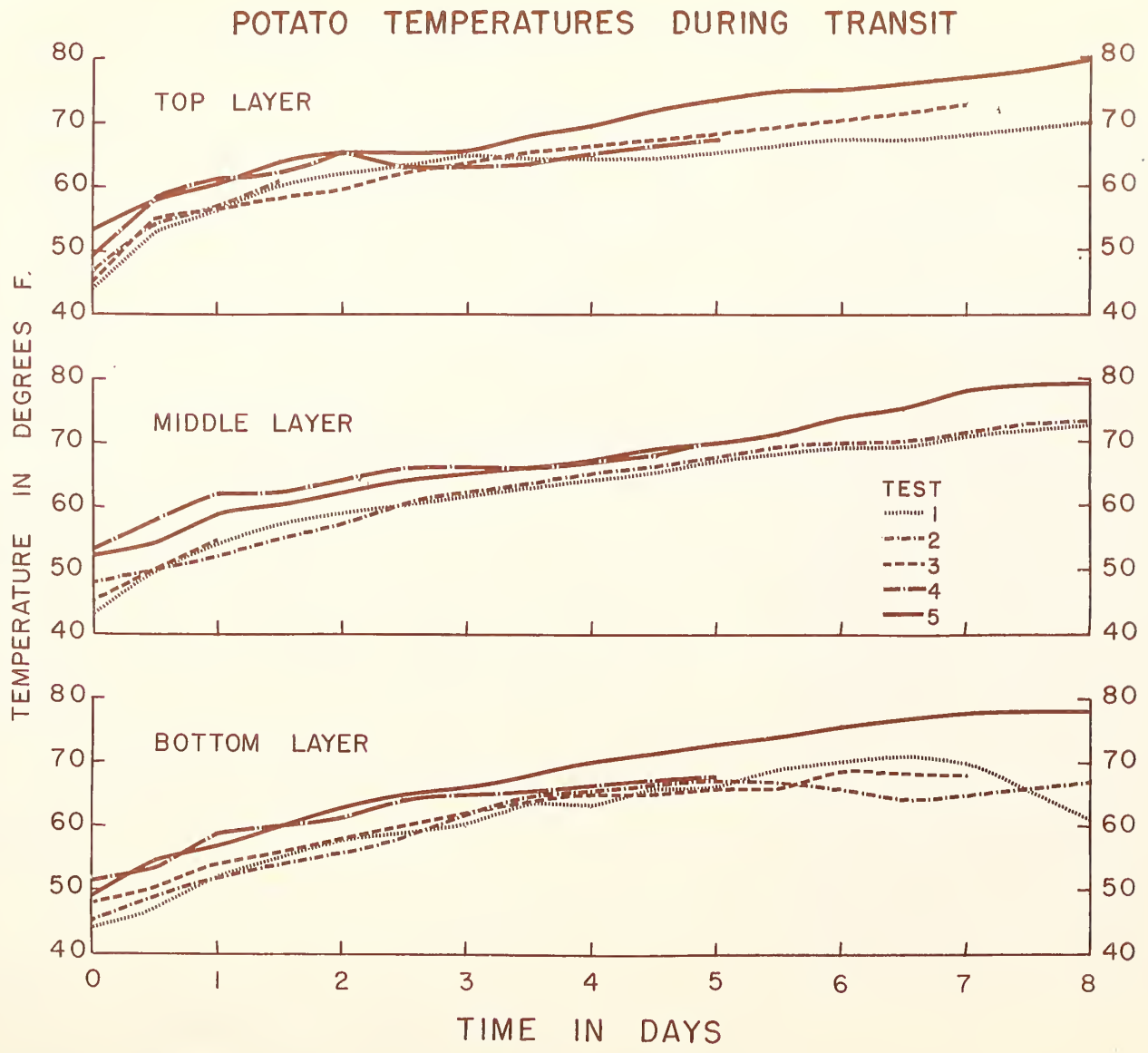


Figure 11.--Transit temperatures for five carloads of potatoes in top, middle and bottom quarterlength positions in the end loaded the first day.

Some of the upper bags had a trace of surface mold on the burlap. This soon disappeared on handling.

The seed pieces in these tests were in excellent condition on arrival and were ready to plant or store. Weight loss was low, averaging 2.7 percent in the top layer, 0.5 percent in the middle layer, and 0.4 percent in the bottom layer bags, for precut seed loaded the first day in each car (table 7). Weight loss was lower in whole than in precut seed.

The 2,500 bags of precut seed from these five test cars were planted in the spring of 1958 on about 125 farms in Connecticut, Massachusetts, Pennsylvania, and Rhode Island.

DISCUSSION

The tests were confined almost entirely to one season. Further tests are needed with potatoes grown under a variety of conditions during different seasons before any broad general conclusions can be reached. More information on plant emergence and on yields from precut seed is also needed. Precutting of seed potatoes at the growing area and healing under controlled conditions during transit should provide advantages to shippers and receivers if proper attention is given to certain details.

Possible benefits include (1) reduction of overhead costs of seed production by reducing required acreage, (2) production of higher quality seed stock, (3) reduction of seed-piece decay, (4) improved emergence by the start of sprouting in transit, and (5) reduction in seed cutting costs.

The use of cars in good condition with fans in good working order is important. Floor papering should be omitted to permit air circulation through the load. Heaters capable of high B.t.u. output are especially important in short-haul shipments when a rapid rise in the temperature of the precut potatoes is needed to insure sufficient healing before the seed pieces are unloaded from the car. A hold motor can help to warm the load, especially if it is used overnight before the loaded car leaves the siding. The alcohol heaters must be serviced carefully since the higher B.t.u. output requires replenishment of fuel more often.

The type of seed cutter used will probably be determined by the cutting rate and the manpower required for operation. Although blocky seed pieces have been preferred by most growers in the past, no major difficulty was experienced with the long seed pieces in these tests.

Preheating the car is important in providing suitable temperatures for the potato seed pieces during transit. The car should be preheated to a temperature as close as possible to the desired carrying temperature for the seed.

Prompt loading is imperative to prevent excessive drying in handling precut seed. After the seed pieces are within the car, which forms a relatively tight enclosure, high relative humidity is maintained around the cut surfaces. No trouble was encountered with cut surfaces sticking together. The movement of the car during transit may have agitated the seed pieces sufficiently to prevent them from sticking together.

The porous nature of the burlap bags and the load type, which has no large openings to allow warm air to bypass parts of the load, insure fairly uniform warming of the seed pieces.

The height of the load, even with 50,000 pounds of potatoes in the car, was satisfactory for the 33-foot end-bunker car used. The top of the load came to just below the fan openings, permitting a free flow of air from the bunker heaters.

Loading of each car extended over a 2-day period in these tests. A shorter period is desirable and with more efficient seed cutters loading could probably be completed in 1 day. This can result in more uniform temperatures, especially if hold motors are used. Prompt loading of the car and closing of the car doors immediately thereafter are especially important when outside temperatures are low.

The moderate rise in temperature above the thermostat setting of 60° F., although desirable from the standpoint of healing of the cut surfaces, may be conducive to decay development if poor seed is used. If it becomes necessary to prevent temperatures from rising too high, certain procedures may be required. Since 60° was reached within 2-1/2 to 3 days after loading, during mild weather the alcohol heaters could be extinguished or removed at that time. This would eliminate the heat from the pilots and might also result in savings in heater charges.

Prospective users of this system of shipping and curing precut seed are cautioned to use only high quality certified seed potatoes and modern rail equipment, and to handle both carefully.

TABLES

TABLE 1.--Temperature (°F.) during loading and transit of precut seed potatoes, Presque Isle, Maine, to York, Pa., March 10-18, 1958 (Test 1)

Location of recording thermometers	At start of loading	Days after start of loading															
		½	1	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7	7½	8
In potato bags																	
End of car loaded 1st day:																	
Top layer	44	53	56	60	62	63	65	64	64	64	65	66	67	67	68	69	70
Middle layer	43	50	54	57	59	60	62	63	64	65	67	68	69	69	71	72	73
Bottom layer	44	47	52	55	58	59	60	65	64	66	66	69	70	71	70	66	61
End of car loaded 2nd day:																	
Top layer			47	55	58	61	64	61	63	63	66	66	66	68	68	70	72
Middle layer			48	52	55	58	59	62	63	64	66	66	68	69	70	71	72
Bottom layer			45	46	52	54	55	62	63	64	65	68	70	71	71	69	66
In air																	
Inside car:																	
At ceiling:																	
Maximum			81		78		77		64		82		70		67		68
Minimum			54		62		64		62		62		65		67		67
Average			62		70		74		63		68		67		67		67
Under floor rack:																	
Maximum			56		59		60		62		59		64		64		58
Minimum			39		44		53		52		52		53		56		52
Average			48		53		56		58		55		58		60		55
Outside car:																	
Under floor:																	
Maximum			42		48		60		55		43		43		47		60
Minimum			39		37		36		37		35		34		33		34
Average			40		40		48		41		39		39		40		44

TABLE 2.--Temperature (°F.) during loading and transit of precut seed potatoes, Presque Isle, Maine, to Lancaster, Pa., March 20-28, 1958 (Test 2)

Location of recording thermometers	At start of loading	Days after start of loading															
		½	1	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7	7½	8
In potato bags																	
End of car loaded 1st day:																	
Top layer	47	54	56	60	Recording thermometer failed during remainder of trip												
Middle layer	48	50	52	55	57	60	62	63	65	66	67	69	70	70	71	73	73
Bottom layer	45	49	52	54	56	58	62	65	65	66	67	67	66	64	65	66	67
End of car loaded 2nd day:																	
Top layer			50	58	61	64	68	63	64	65	68	68	68	70	71	73	73
Middle layer			49	54	56	58	62	63	64	66	68	68	70	73	74	75	75
Bottom layer			49	52	53	54	58	63	66	68	67	70	66	64	63	66	68
In air																	
Inside car:																	
At ceiling:																	
Maximum			88		78		76		66		66		66		68		68
Minimum			58		59		63		63		65		65		66		67
Average			64		68		72		65		65		66		67		68
Under floor rack:																	
Maximum			58		58		55		61		61		62		62		61
Minimum			36		40		49		52		53		60		55		58
Average			45		48		52		57		56		61		59		60
Outside car:																	
Under floor:																	
Maximum			40		38		43		53		53		50		47		48
Minimum			30		33		37		37		42		39		40		33
Average			36		35		39		45		46		43		43		41

TABLE 3.--Temperature (°F.) during loading and transit of precut seed potatoes, Presque Isle, Maine, to Ironton, Pa., March 31 - April 7, 1958 (Test 3)

Location of recording thermometers	At start of loading	Days after start of loading													
		½	1	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7
In potato bags															
End of car loaded 1st day:															
Top layer	45	55	56	58	59	62	63	65	66	67	68	69	70	71	73
Middle layer	45	50	54	Recording thermometer failed during remainder of trip.											
Bottom layer	48	50	54	56	58	60	62	64	65	65	66	66	69	68	68
End of car loaded 2nd day:															
Top layer			48	52	55	57	58	60	62	63	65	67	67	68	70
Middle layer			47	48	52	54	57	60	61	63	64	66	67	68	70
Bottom layer			48	49	51	53	56	58	60	62	63	64	67	68	69
In air															
Inside car:															
At ceiling:															
Maximum			83		75		82		72		71		73		70
Minimum			56		56		61		62		66		68		70
Average			71		66		72		68		69		70		70
Under floor rack:															
Maximum			71		54		60		62		63		65		61
Minimum			40		40		52		57		57		58		61
Average			46		50		56		59		60		61		61
Outside car:															
Under floor:															
Maximum			38		47		40		49		63		60		60
Minimum			37		37		37		40		43		43		47
Average			38		42		42		45		54		53		52

TABLE 4.--Temperature (°F.) during loading and transit of precut seed potatoes, Fort Fairfield, Maine, to Rockville, Conn., April 9 - 14, 1958 (Test 4)

Location of recording thermometers	At start of loading	Days after start of loading											
		½	1	1½	2	2½	3	3½	4	4½	5	5½	6
In potato bags													
End of car loaded 1st day:													
Top layer	49	58	61	61	65	63	63	63	65	66	67		
Middle layer	53	58	62	62	64	66	66	66	67	68	70		
Bottom layer	51	53	59	60	61	64	65	65	65	66	67		
End of car loaded 2nd day:													
Top layer			55	59	64	64	64	64	65	66	67	68	69
Middle layer			54	57	62	65	66	66	67	68	70	71	71
Bottom layer			53	56	58	63	65	66	66	67	69	68	65
In air													
Inside car:													
At ceiling:													
Maximum			84		79		74		61		66		66
Minimum			53		59		61		61		61		41
Average			68		64		66		61		64		58
Under floor rack:													
Maximum			71		64		63		64		64		67
Minimum			39		39		46		46		58		47
Average			55		47		55		59		62		61
Outside car:													
Under floor:													
Maximum			43		44		57		44		64		65
Minimum			38		30		30		37		42		45
Average			41		38		44		41		55		55

TABLE 5.--Temperature (°F.) during loading and transit of precut seed potatoes, Fort Fairfield, Maine, to Northampton, Mass., April 14 - 22, 1958 (Test 5)

Location of recording thermometers	At start of loading	Days after start of loading															
		½	1	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7	7½	8
In potato bags																	
End of car loaded 1st day:																	
Top layer	53	58	60	64	65	65	65	68	69	72	73	75	75	76	77	78	80
Middle layer	52	54	59	60	62	64	65	66	67	69	70	71	74	75	78	79	79
Bottom layer	49	55	57	60	63	65	67	68	70	71	73	74	76	77	78	78	78
End of car loaded 2nd day:																	
Top layer			54	60	64	65	66	68	68	72	74	78	[1] 79				
Middle layer			50	58	60	63	64	67	68	69	72	74	76	78	80	83	83
Bottom layer			54	57	59	64	66	68	70	72	73	74	[2] 76				
In air																	
Inside car:																	
At ceiling:																	
Maximum			81		74		73		69		75		75		77		78
Minimum			60		61		64		66		69		72		73		77
Average			64		65		66		68		73		74		75		78
Under floor rack:																	
Maximum			71		62		64		65		69		67		68		70
Minimum			46		47		53		56		60		58		64		64
Average			56		55		59		63		66		63		67		69
Outside car:																	
Under floor:																	
Maximum			69		57		69		58		75		77		72		74
Minimum			30		30		37		39		36		44		47		52
Average			45		44		53		46		57		67		61		65

[1] Record indistinct for remainder of trip.
[2] Chart temporarily stuck.

TABLE 6.--Time required for bagged precut seed potatoes to reach 50°, 55° or 60° F. and time over 60° during transit from Maine to other growing areas

Layer and test number	Total time in car	Bags loaded first day				Bags loaded second day			
		Time required to reach--			Time over 60°F.	Time required to reach--			Time over 60°F.
		50° F.	55° F.	60° F.		50° F.	55° F.	60° F.	
Top:	*Days*	*Days*	*Days*	*Days*	*Days*	*Days*	*Days*	*Days*	*Days*
1.....	8	½	½	1½	6½	½	½	1½	5½
2.....	8	½	1	1½	6½	0	½	1	6
3.....	7	½	1	2½	4½	½	1	2½	3½
4.....	5	½	½	1	4	0	0	1	3
5.....	8	0	½	1	7	0	½	½	6½
Average.		½	¾	1½		½-	½	1¼+	
Middle:									
1.....	8	½	1½	2½	5½	½	1	2½	4½
2.....	8	½	1½	2½	5½	½	1	2	5
3.....	7	½	1½	2½	4½	1	2	2½	3½
4.....	5	0	½	1	4	0	½	1	3
5.....	8	0	1	1½	6½	0	⅓	1	6
Average.		½	1¼-	2		½-	1	1¾	
Bottom:									
1.....	8	1	1½	3	5	1	2	2½	4½
2.....	8	1	2	3	5	½	2	2½	4½
3.....	7	½	1½	2½	4½	1	2	3	3
4.....	5	0	1	1½	3½	0	½	1½	2½
5.....	8	½	½	1½	6½	0	½	1½	5½
Average.		½+	1¼+	2¼+		½	1½-	2¼-	

TABLE 7.--Weight loss in precut[1] seed potatoes during transit from Maine to other potato growing areas

Position[2] of bags in car	Test 1	Test 2	Test 3	Test 4	Test 5	Average 5 tests
End loaded 1st day:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Top layer	3.5	2.2	3.3	3.1	1.6	2.7
Middle layer	1.0	.3	.7	.5	.2	.5
Bottom layer	.4	.2	1.0	.1	.4	.4
End loaded 2nd day:						
Top layer	2.6	2.0	---	2.4	1.2	2.0
Middle layer	1.1	.1	.3	.9	.3	.5
Bottom layer	1.2	.5	1.1	.7	.0	.7

[1] Weight loss in comparable whole (uncut) seed potatoes placed in bags adjacent to bags of precut seed used in these determinations in the 1st end loaded, tests 1 and 3, averaged 0.7 percent in the top layer, 0.3 percent in the middle layer, and 0.05 percent in the bottom layer.

[2] Centerline quarterlength position used throughout these tests.

LITERATURE CITED

(1) Anderson, J.
1778. Miscellaneous Experiments and Observations on the Culture of Potatoes and Some Other Plants; Reporting tests as Early as 1776. Letters and Papers on Agriculture. Bath and West of England Soc., V. 4, ed. 2, p. 7-92.

(2) Artschwager, E.
1927. Wound Periderm Formation in the Potato as Affected by Temperature and Humidity. Jour. Agr. Res. 35:995-1000.

(3) Berchtold, F. G. von
1842. Die Kartoffeln, Chapter XVI, Prague, 1842. Literature der Kartoffelphanze, 542-46.

(4) Hawkins, A.
1958. Seed Size as Well as Spacing Affects Potato Yields. Eastern States Cooperator. April 1958, p. 26 and 27.

(5) Kny, L.
1889. Über die Bildung des Wundperiderms an Knollen in ihrer Abhangigkeit von ausseren Einflussen. Ber. Deutch. Bot. Ges. 7:154-168.

(6) Priestly, J. H., and Woffenden, L. M.
1923. The Healing of Wounds in Potato Tubers and their Propagation by Cut Sets. Ann. Appl. Biol. 10:96-115.

(7) Reid, W. J., Wright, R. C., and Peacock, W. M.
1940. Prevention of Damage by the Seed-corn Maggot to Potato Seed-pieces. U. S. Dept. Agr. Tech. Bul. 719, 37 pp.

(8) Stuart, W., Lombard, P. M., Vosbury, M. C., and others.
1924. Size of Potato Sets: Comparisons of Whole and Cut Seed. U. S. Dept. Agr. Bul. No. 1248, 44 pp.

(9) Wright, R. C., Peacock, W. M., and Whiteman, T. M.
1934. Effect of Subsequent Yields of Storing Cut Seed Potatoes at Different Temperatures and Humidities. U. S. Dept. Agr. Tech. Bul. 394, 20 pp.